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CEPHALOPOD REMAINS FROM THE STOMACH OF A SHORT-FINNED PILOT
WHALE COLLECTED NEAR SANTA CATALINA ISLAND, CALIFORNIA

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Considerable evidence suggests that long-finned pilot whales (*Globicephala melaena*) feed predominately on cephalopods in the Atlantic Ocean (Mercer, 1975; Norman and Fraser, 1937; Sergeant, 1962; Sergeant and Fisher, 1957). It is generally presumed that the short-finned pilot whale (*G. macrorhynchus*) of the Pacific preferentially consumes squid (Brown, 1960, 1962; Caldwell et al., 1971; Fiscus, 1982; Kritzler, 1949; Leatherwood et al., 1982; Reilly, 1977, 1978). However, squid beaks in the stomach of this delphinid have been reported only twice (Kritzler, 1952; Hall et al., 1971) and neither account identified the species of squid. Norris and Prescott (1961) described group behavior in "feeding schools" of short-finned pilot whales among schools of squid but did not identify the species. Our note provides the first identification of squid beaks from the stomach of a short-finned pilot whale collected dead from the Pacific Ocean.

Six floating dead pilot whales were observed from the air near Santa Catalina Island (ca. 35 km SSW Los Angeles, CA) on 16 and 17 December 1980. They were scattered along a 20 km area from the shoreline to 5 km off the southwestern end of the island. On 18 December we traveled by boat to this vicinity and located and examined three dead *G. macrorhynchus* and two California sea lions (*Zalophus californianus*). Two of the whales had numerous post-mortem abdominal and caudal bites, which we observed being made by feeding blue sharks (*Prionace glauca*). We collected one sea lion (JRH 091) and towed one pilot whale (JRH 089) 35 km to the Catalina Marine Science Center, Big Fisherman Cove, Santa Catalina Island, for examination.

The standard length (snout tip to fluke notch) of the pilot whale was 463.0 cm; this value could be exaggerated from its length in life because we towed the carcass by the flukes. Other external measurements were made and are on file at the Southwest Fisheries Center, La Jolla, CA. Even though the whale was in an initial stage of decomposition, we looked for gross signs of trauma or pathology. We found none, either because of the decomposition or more likely because of the absence of such. The internal parasite load was very light: only a few (<15) cestode cysts (*Monorygma* sp.) and flukes (*Nasitrema* sp.) were found and collected during a gross examination of all muscle and organ systems. The stomach and its contents, reproductive tract, complete skeleton, and parasites were collected and deposited in the collections of the Southwest Fisheries Center.

The stomach contained about 20 l of a moderately digested (or decomposed) slurry of the "market" squid, *Loligo opalescens*. We decanted (and subsequently inadvertently discarded) about 18 l of the slurry and collected and froze the stomach with the remaining, heavier contents (2,580 ml) for later analysis. The stomach and its contents were defrosted in the laboratory. The stomach was everted and contents rinsed into dishes for examination. Whole and large pieces of squid were removed by hand. All other contents were washed through 5.0 mm and 1.0 mm screens. Beaks were picked from the screens after each washing. Remaining organic material was air dried and examined for teleost otoliths. The beaks were stored in 70% ethanol for subsequent identification.

The examined contents were composed almost entirely of whole or moderately digested remains of *L. opalescens*, represented by 15 intact individuals (dorsal mantle length \bar{X} = 128 mm, range 112–142 mm, n = 11) and an additional 188 beaks (99 lowers, 89 uppers). About one-half of these beaks were picked in pairs from partially digested buccal tissue. Additionally, one upper beak of the north Pacific giant squid, *Moroteuthis robusta*, and one lower beak from *Histioteuthis dofleini* were present. No fish otoliths or bones were found.

Several lines of circumstantial evidence lead us to believe that the pilot whale we examined had been a healthy individual that had accidentally suffocated in a net while feeding on squid. 1) Our necropsy results were typical for drowned cetaceans; within the limits imposed by decomposition we did not find injuries or pathological conditions suggestive of the cause of death (the lungs of drowned cetaceans do not fill with water). At necropsy the stomach was packed with whole or only moderately digested squid, indicating very recent feeding. It is our experience that the stomachs of diseased or moribund cetaceans are generally empty, whereas stomachs of cetaceans which die accidentally in fishing nets are more likely to contain prey items. 2) Reports from island residents and observations made during our aerial surveys indicated that numerous dip-net and purse-seine vessels had been fishing for spawning *L. opalescens* in this area throughout the month prior to our collection. Three of the six dead whales observed from the air and two of three observed floating at sea were without flukes and terminal vertebrae. The entangled flukes of dead whales typically are severed to facilitate removal from squid purse-seines (California Department of Fish and Game, pers. comm.). 3) The blue sharks observed feeding on the whales were utilizing them as carrion; blue sharks feed predominantly on small schooling fish such as the northern anchovy (*Engraulis mordax*), on cephalopods including *L. opalescens* and two histioteuthids (Tricas, 1979), but not on live large cetaceans.

The presence of *L. opalescens* in the stomach of our specimen confirms the presumption of others that *G. macrorhynchus* feeds predominantly on this species of squid in waters offshore southern California. *Loligo opalescens* is seasonally epipelagic, inhabiting open coastal waters most of the year and moves into nearshore waters adjacent to submarine canyons, escarpments, or islands to mate and spawn (Recksiek and Frey, 1978). Large mating and spawning schools of market squid aggregate in the upper 20 m of water during winter nights near Santa Catalina Island (Fields, 1965), thus becoming more accessible to predators such as marine mammals. The market squid found in the stomach of our specimen probably were spawning adult individuals, based on a comparison of our mantle length measurements and beak sizes with the findings of others (Hochberg and Fields, 1980; Wolff, 1982).

The cephalopods *H. dofleini* and *M. robusta* have been found previously in the stomachs of marine mammals: the northern fur seal, *Callorhinus ursinus* (Fiscus, 1982), and the sperm whale, *Physeter catodon* (Clarke and MacLeod, 1980; Rice, 1963). *Histioteuthis dofleini* also has been reported from the stomachs of one California sea lion (Antonelis and Fiscus, 1980), one spotted dolphin, *Stenella attenuata* (Perrin et al., 1973), and two beaked whales, *Mesoplodon carlhubbsi* (Mead et al., 1982). We estimate that our specimen of *H. dofleini* would have weighed about 110 g, based on a regression of lower beak rostral length (L.R.L. = 0.55 cm; Clarke, 1962). Based on the relative size (similar to *L. opalescens*), abundance, and distribution of *H. dofleini* (Voss, 1969; Young, 1972), Hochberg (pers. comm.) suspects that a reexamination of squid beaks collected from marine mammal stomachs of the eastern North Pacific, which remain unassigned or have been identified only to the familial level, will result in their identification as *H. dofleini*.

Moroteuthis robusta is a deep water inhabitant (100–500 m) considered abundant along the North Pacific rim from Japan to southern California (Clarke, 1966; Roper and Young, 1975). Fiscus (1984) and Rice (1963) identified *M. robusta* as the species of squid found most frequently in the stomachs of sperm whales off central California. There are only nine published records of *M. robusta* south of Point Conception, California (Hochberg, 1974); our beak is the only record from a marine mammal stomach for the southernmost portion of this species' range.

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